SCIENCE NEED STATEMENT

Transport of Contaminants-- Rates of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface

Identification No.: RL-SS27-S
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): Broad need potentially applicable to multiple operable units.
PBS No.: RL-SS04 (RL-VZ01)
Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])
TSD Title:
Operable Unit (if applicable): N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

_X__ 1. Critical to the success of the ACPC
____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

***Need Title*:** Transport of Contaminants-- Rates of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface

Need/Opportunity Category: Science Need

***Need Description*:** For Hanford site conditions, determine the effect on contaminant form (e.g. speciation/complexation/reaction) of coupling important abiotic and biogeochemical reactions for which independent rates of reaction are known.

In systems where reaction coupling may occur, it becomes important to determine how movement of a fluid of reactive components affects oxidation/reduction, aqueous and surface complexation, precipitation/dissolution, and interphase mass transfer. Coupling with convective and dispersive transport processes may result in different reaction pathways for the system, and science is needed to quantify these effects. Science is needed to understand the response of the

biogeochemical system to the presence of zones ranging from transport-limited to reaction rate-limited conditions. Multiphase transport in heterogeneous media may need to incorporated in a broader understanding of a subsurface system. It will be important to establish how the biogeochemical system behaves under remediation stresses (chemical, hydraulic, thermal, phase changes).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

***Problem Description*:** Numerous abiotic and biogeochemical reactions occur in complex geochemical systems. Individual rates can be determined in laboratories; in natural settings, these rates may not adequately describe the behavior of contaminant plume because coupling between chemical reactions and transport processes occurs. Depending on groundwater velocities, reactions that are transport-controlled may become more or less favored in the natural setting, and relative contributions of different reactions to buffering the chemical system could change. The potential for coupling of abiotic and biogeochemical reactions for Hanford contaminants must be assessed as part of selection of appropriate remedial alternatives.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then the relative importance of transport limitations vs. reaction-rate limitations for important Hanford plumes will be known and incorporated into appropriate remedial technologies. Such information could affect the selection of technologies because the rate information is important to technology performance.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS28

Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

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